Farad, see capacitor FCC (Federal Communications Commission), 413 FEC (forward error correction), 207 ferrite, 279 FET. see transistor fiber optic cable, 108, 197-198 single and multi mode, 198 splicing, 198 FIFO (first-in-first-out), 236-237 clock domain crossing, 95 data rate matching, 95-96 defined, 94 FPGA usage, 261 interfaces. 95 internal structure, 94 overflow and underflow, 94 source-synchronous bus interfacing, 369-370 filter active, 331-333 ADC and DAC, 345, 348 anti-aliasing for ADC, 350-351 bandpass, 286-287 band-reject, 286-287 cutoff frequency, 283-284 defined, 283 EMI reduction. 414 ESD protection, 416-417 gain, 283-284 highpass, 286 lowpass, 283-285 pass and stop bands, 285 passive, 283 PLL feedback loop, 362 second-order, 285-286 transformer, 290 firmware, 57 flash bit structure, 81 block protection, 85 boot block, 83 defined, 81 erasure, 84 NOR versus NAND, 82 flip-flop 7400 family, 42 defined, 18 falling/rising-edge trigger, 18-19 FPGA, 257-258 FPGA I/O, 261-263

metastability, 234-235 PLD, 253-254 timing parameters, 23-24 using Verilog, 225-226 floating point, 138, 165-167 floorplanning, see FPGA flow control, see handshaking FM (frequency modulation), 109 forward bias, 293 four-corner handshaking, see handshaking Fourier analysis, see frequency-domain analysis Fowler-Nordheim Tunneling, 81 FPGA (field programmable gate array) clock distribution, 259-260 defined, 257 floorplanning, 259 internal timing, 258 logic cell, 257-258, 261 RAM. 260-261 routing, 258-259 third party cores, 261 frame, network, 111, 194, 207 framing defined, 45, 99 detection logic, 202-203 networks, 112 UART. 99-101 frequency-domain analysis, 279-283, 341 decibel usage, 281-282 FSM (finite state machine) binary and one-hot encoding, 243-244 bus interface design example, 239, 241-242 defined. 237 Moore and Mealy types, 239 partitioning, 243 pattern matching design example, 238 pipelining, 245-247 serial communications design example, 47 state transition diagram, 48, 238 Verilog design, 239-241 FSK (frequency shift keying), 109 full-adder, 14-15 full-duplex, 113 fundamental frequency, 280 fuse PLD, 252-253 power, 389 PROM, 79

G

gain, *see* filter GAL, 252–253 Galois Field, 200, 209 gate, FET, *see* transistor Gennum Corporation, 203 glue logic, 227–228 ground earth and signal, 390 ESD, 415–417 GND symbol, 44–45 plane and impedance, 398–399 reference node, 268

H

half-adder, 14 half-duplex, 113, 217 half-power point, see filter, cutoff frequency handshaking, 99-100 four-corner method, 236 RS-232, 104 XON/XOFF, 100, 107 harmonic frequency, 280 Harvard architecture, 149, 155, 168-169 HDL (hardware description language), 221-226 behavioral and RTL, 222, 228-229 sensitivity list, 224 test bench, 224 Verilog, 222-226 VHDL, 222 header, network, 111, 194 heat sink, 375-376, 382 HEC (header error check), 209 henry, see inductor hertz, 24 hexadecimal, base-16, 11 hold time, flip-flop, see flip-flop hub, star network, 110-111, 217 hysteresis, 335

I

I/O (input/output), 56 bus expansion, 70–72 direct memory access, 68–69 FPGA structure, 261–263 interaction with cache, 155 pads and die size, 250–251 performance, 171–172

PLD, 253-254 timing in FPGA, 261 voltage in PLD, 257 I²C (inter-IC bus), 119–120 IBM, 71, 134 IC (integrated circuit), 35 IEEE (Institute of Electrical and Electronics Engineers) 1149.1, see JTAG 802.3. see Ethernet Ethernet MAC addresses, 194 floating-point, 165-167 immediate addressing, 74 impedance capacitor, 274, 411 defined, 274 inductor, 276, 417 logic driver output, 407 match with transformer, 291 obtaining magnitude, 282-283 PCB. 400-402 power distribution, 393 transmission line, 398, 400-402 implied addressing, 73 index register, 75 indexed addressing, 75 indirect addressing, 74-75 inductor description, 276 ESD handling, 417 filter, 285-286 noise filtering, 276-277 nonideal model, 278 switching regulator, 386-387 transformer, 288-291 ingot, semiconductor, 36 Innoveda, 409, 436 instruction basic types, 58 CISC and RISC, 145-149 decoding, 59, 146-148 defined, 56 reordering, 164 set. 56. 169 Intel, 39, 83, 121, 125-126, 134, 199, 216 interrupt computer design example, 66-67 defined, 62 instruction, 123, 136 logic design example, 232-233